* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the switching power supply equipment which carries out on-off control of the transistor based on a pulse.
[0002]
[Description of the Prior Art] In order to fixed-ize output voltage, an PWM (Pulse Density Modulation) pulse is formed, and the switching power supply equipment which is intermittent in a direct current and performs voltage adjustment is widely used by turning on and off the transistor connected to the output transformer by this PWM pulse at the serial. Drawing 5 shows theoretically the condition of each part in conventional switching power supply equipment. If a square wave pulse (PWM pulse) as shown in drawing 5 (A) is added to the base of a transistor through a drive circuit, as shown in drawing 5 (B), it corresponds to a square wave pulse, and is almost fixed base current IB. It flows. On the other hand, it is collector current IC of a transistor. As shown in drawing 5 (C) for the inductance of an output transformer, it inclines and increases. However, in order to make loose the standup of the electrical potential difference between collector emitters of a transistor and to reduce switching loss and a switching noise, in having the capacitor connected to diode for the purpose of the cure against a noise at juxtaposition in the snubber circuit which changes from the diode connected to juxtaposition, and a capacitor to the primary coil of the capacitor arranged in parallel by the transistor or an output transformer, a big current flows by discharge of this etc. for a moment.
[0003]
[Problem(s) to be Solved by the Invention] By the way, since the current which flows at the time of this standup flows before the electrical potential difference VCE between collector emitters of a transistor becomes zero, as shown in drawing 5 (C), it serves as power loss.
[0004] Then, the purpose of this invention is to offer the switching power supply equipment which can attain reduction of power loss.
[0005]
[Means for Solving the Problem] The series circuit of the primary coil of a transformer and transistor to which this invention for attaining the above-mentioned purpose was connected between the end of DC power supply, and the other end, The rectification smoothing circuit connected to the secondary coil and said secondary coil of said transformer, The pulse generating circuit which generates the square wave pulse for carrying out on-off control of said transistor, It connects between said pulse generating circuits and bases of said transistor, and is involved in the switching power supply equipment which consists of the drive circuit which has a loose inclination [near the standup of said square wave pulse], and which supplies the base current of a trapezoidal wave to said transistor mostly.
[0006]
[Function and Effect of the Invention] In this invention, since base current has an inclination and starts, the collector current at the time of ON initiation is controlled, and power loss becomes small. Moreover, since it becomes about 1 constant value after base current starts, it is restricted that collector current

becomes excessive.
[0007]
[Example] Next, with reference to drawing 1 - drawing 4 , the separate excitation type switching power supply equipment concerning the example of this invention is explained.
[0008] In drawing 1 , the series circuit of the primary coil 6 of a transformer 5 and a transistor 7 is connected between the grand terminal, the output terminal 3 of DC power supply 2, i.e., the DC-power-supply terminal, which consists of the rectification smoothing circuit connected to the AC-power-supply terminal 1, 4. The snubber circuit which changes from diode 8 and a capacitor 9 to juxtaposition to the primary coil 6 which has an inductance is connected, parallel connection of the resistance 10 is carried out to a capacitor 9, and parallel connection of the capacitor 11 for noise absorption is carried out to diode 8. Moreover, the capacitor 12 for partial resonance is connected to juxtaposition at the transistor 7.

[0009] The load 18 is connected to the secondary coil 13 of a transformer 5 through the output rectification smoothing circuit 16 and output terminal 17 which consist of diode 14 and a capacitor 15. Diode 14 has the directivity turned on at the "off" period of a transistor 7.
[0010] Control and the drive circuit 19 of a transistor 7 have a power supply terminal 20, the grand (common) terminal 21, and an output terminal 22. The grand terminal 21 is connected to the grand terminal 4 of DC power supply 2, and the output terminal 22 is connected to the base of a transistor 7. Control and the drive circuit 19 control a transistor 7 including a photo transistor 23 to supply a fixed electrical potential difference to a load 18.
[0011] As a power circuit 24 of control and the drive circuit 19, the 3rd coil 25 of a transformer 5, diode 26, the capacitor 27 for smooth, and the starting resistance 28 are formed. Since this switching power supply equipment is an on-off mold (reverse mold) with which the output rectifier diode 14 is turned on at the period when a transistor 7 is off, an almost fixed electrical potential difference is obtained by the 3rd coil 25 at the "off" period of a transistor 7. Parallel connection of the capacitor 27 for smooth is carried out to the 3rd coil 25 through diode 26, and this upper limit is connected to the power supply terminal 20. Therefore, a capacitor 27 functions as a power source of control and the drive circuit 19. It connects between the terminal 3 of a power source 2, and a capacitor 27, and resistance 28 functions as a starting resistance.
[0012] In order to detect the electrical potential difference of a load 18 and to control a photo transistor 23, the resistance 29 and 30 for partial pressures is connected between an output terminal 17 and a gland, and this partial pressure point is connected to one input terminal of the error amplifier 31. The error amplifier 31 outputs the electrical potential difference corresponding to the difference of the reference voltage of the source 32 of reference voltage and the detection electrical potential difference which were connected to the input terminal of this another side, and drives light emitting diode 33. Optical coupling of the light emitting diode 33 is carried out to the photo transistor.
[0013] Control and the drive circuit 19 of drawing 1 consist of the PWM pulse generating circuit 34 and the drive circuit 35, as shown in drawing 2 . The PWM pulse generating circuit 34 is divided roughly, has the electrical-potential-difference comparator 36, the off width-of-face control circuit 37, the ON width-of-face control circuit 38, and the source 39 of reference voltage, and sends an PWM pulse to the input terminal 40 of the drive circuit 35. if each part is explained in more detail -- the off width-of-face control circuit 37 -- capacitor C1 The 1st, 2nd, and 3rd resistance R1, R2, and R3 A transistor Q11, two diodes D1, and D2 from -- it changes. Capacitor C1 They are a transistor Q11 and diode D1 between a power supply terminal 20 and a gland. It minds and connects. 1st resistance R1 It is a capacitor C1 in order to form a discharge circuit. It connects with juxtaposition. Capacitor C1 Upper limit is connected to the negative input terminal of a comparator 36. the base of a transistor Q11 -- resistance R3 while minding and connecting with the source 39 of reference voltage -- resistance R2 Diode D2 from -- capacitor C1 which changes It connects with the output terminal of a comparator 36 through the charge halt control circuit. The plus input terminal of a comparator 36 is resistance R3. While minding and connecting with the source 39 of reference voltage, it is resistance R2. Diode D2 It minds and connects also with the output terminal of a comparator 36.

[0014] The ON width-of-face control circuit 38 is a capacitor C2. It consists of a transistor Q12, a transistor Q13, NOT circuit (inverter) 41, and the photo transistor 23 as a charge controlling element.
[0015] Capacitor C2 Upper limit is connected to a power supply terminal 20 through a photo transistor 23, and the lower limit is connected to the gland. This capacitor C2 In order to connect an electrical potential difference VC 2 with a comparator 36, a transistor Q12 is connected between the plus input terminal of a comparator 36, and a gland, and the base of this transistor Q12 is a capacitor C2. It connects with upper limit. Moreover, capacitor C2 In order to connect discharge with the output of a comparator 36, it is a capacitor C2. It receives, a transistor Q13 is connected to juxtaposition as a discharge controlling element, and the output terminal of a comparator 36 is connected to the base of a transistor Q13 through NOT circuit 41.
[0016] The drive circuit 35 for driving a transistor 7 based on the output pulse of the PWM pulse generating circuit 34 has the output terminal 22 and the power supply terminal 42, and the grand terminal 43 other than the PWM pulse input terminal 40. The drive circuit 35 of drawing 2 is the 1st, 2nd, 3rd, and 4th transistors Q1, Q2, Q3, and Q4, as shown in drawing 3 in detail. The constant current-ized circuit 44, diode 45, and 1st capacitor calcium The 2nd capacitor Cb It consists of diode 46 and resistance 47. The 1st transistor Q1 It is a darlington transistor, and consists of two transistor Q1a and Q1b, this collector is connected to a power supply terminal 42, and this emitter is connected to the output terminal 17 through resistance 47 and diode 46. In addition, in diode 46, it is the 2nd capacitor Cb. Parallel connection is carried out. The 1st transistor Q1 The base is connected to the power supply terminal 42 through the constant current-ized circuit 44. The 2nd transistor Q2 The base is connected to the PWM pulse input terminal 40, and this collector is the 1st transistor Q1. It connects with the base and this emitter is connected to the grand terminal 43. The 3rd transistor Q3 The reverse bias of the transistor 7 is carried out, and this collector is the capacitor Cb for reverse biases. It connects, this emitter is connected to the grand terminal 43, and this base is connected to the PWM pulse input terminal 40. The 1st transistor Q1 Between the base and the grand terminal 43, the 1st capacitor calcium is connected through three diodes 45. The 4th transistor Q4 1st capacitor calcium It connects with juxtaposition and this base is connected to the PWM pulse input terminal 40.
[0017] Next, with reference to the wave form chart of drawing 4 , actuation of the switching power supply equipment of drawing 1 - drawing 3 is explained. The PWM pulse generating circuit 34 of drawing 2 generates the square wave shown in drawing 4 (A). This square wave is a high level corresponding to a low and a "off" period corresponding to the "on" period of the main switching transistor 7. The 2nd, 3rd, and 4th transistors Q2, Q3, and Q4 As shown in drawing 4 (C), (D), and (E), it is turned off to the low period of the PWM pulse of drawing 4 (A), and is turned on at a high-level period. On the other hand, it is the 1st transistor Q1. As shown in drawing 4 (B), it is turned on at the low period of an PWM pulse, and base current is supplied to the main switching transistor 7. This base current IB 1st capacitor calcium As it does not become constant value during the whole term since it prepared, but shown in drawing 4 (G), it is T1 in early stages of "on" period Ton. It has an inclination. Namely, "off" period Toff of the main switching transistor 7 It sets and is the 4th transistor Q4. It is turned on and is the 1st capacitor calcium. It discharges. At following "on" period Ton, it is the 4th transistor Q4. Since it becomes off, it is the 1st capacitor calcium. Charge becomes possible and it is the 1st capacitor calcium. It charges according to the current supplied through the constant current-ized circuit 44. From the constant current-ized circuit 44, the current I supplied lets diode 45 pass, and is the 1st capacitor calcium. It flows. Since the 1st capacitor calcium is charged with the inclination decided by the value of the current supplied to the 1st capacitor calcium, and the 1st capacitor calcium from the constant current-ized circuit 44, the electrical potential difference of Va of drawing 3 comes to be shown in (F) of drawing 4 . if the electrical potential difference of Va starts -- the electrical potential difference of Va to the 1st transistor Q1 the current of the value which lengthened the electrical potential difference between the base emitters of the part (VF) for a forward voltage drop and the main switching transistor 7 of the electrical potential difference between base emitters, and diode 46, and broke the value by resistance 47 -- base current IB of the main switching transistor ****** -- as shown in (G) of drawing 4 , it flows. It is base current IB as the value of the 1st capacitor calcium becomes large. Initial T1 An

inclination cuts loosely. when the electrical potential difference of the 1st capacitor calcium is saturated, it is shown in drawing 4 (G) -- as -- period T2 **** -- base current IB It becomes about 1 law. Base current IB of the main switching transistor 7 If it has an inclination and starts as shown in drawing 4 (G), it is this collector current IC. Base current IB It is responded and restricted. For this reason, the discharge current of the capacitors 11 and 12 shown in drawing is also restricted, and the current of the shape of a mustache which flows at the beginning of "on" period Ton also becomes small. Therefore, collector current IC shown in drawing 4 (H) The power loss by the product with the electrical potential difference VCE between collector emitters becomes small. Moreover, base current IB Since it is a trapezoidal wave-like and does not increase rather than constant value as shown in drawing 4 (G), it is collector current IC. It can prevent becoming excessive.

[0018] The 3rd transistor Q3 "off" period Toff The 2nd capacitor Cb It functions in order to carry out the reverse bias of the transistor 7 on an electrical potential difference.

[0019] According to the circuit of drawing 3 , it is the 1st capacitor calcium. The 4th transistor Q4 It is base current IB by the addition of the easy circuit which consists of diode 45. An inclination can be given and the switching loss at the time of a turn-on can be reduced easily.

[0020]

[Modification(s)] This invention is not limited to an above-mentioned example, and the next deformation is possible for it.

(1) The PWM pulse generating circuit 34 is not limited to drawing 2 , and it can also be constituted so that pulse width may be changed with current detection.

(2) It can constitute in an on--on format.

[Translation done.]

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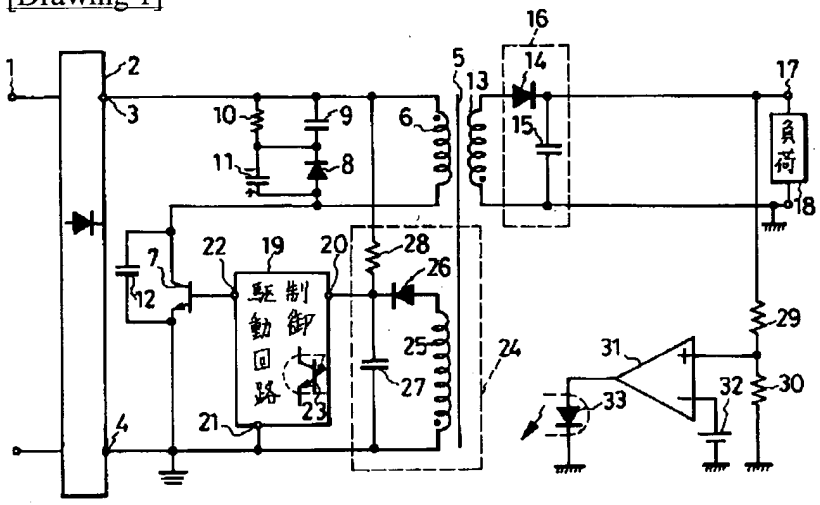
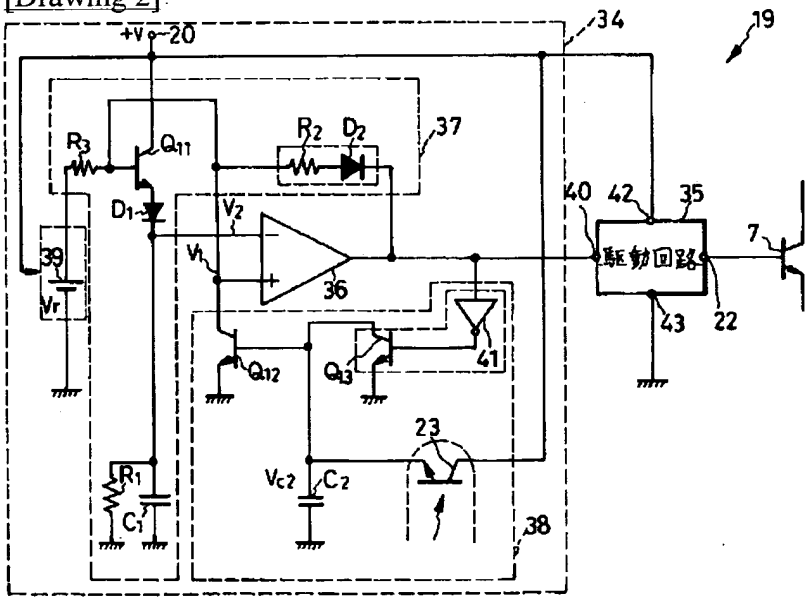
DRAWINGS

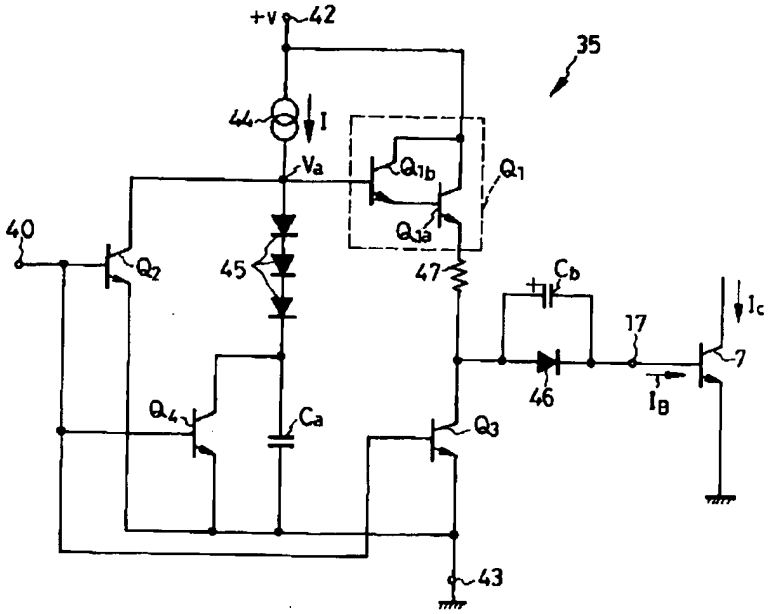
[Drawing 1]



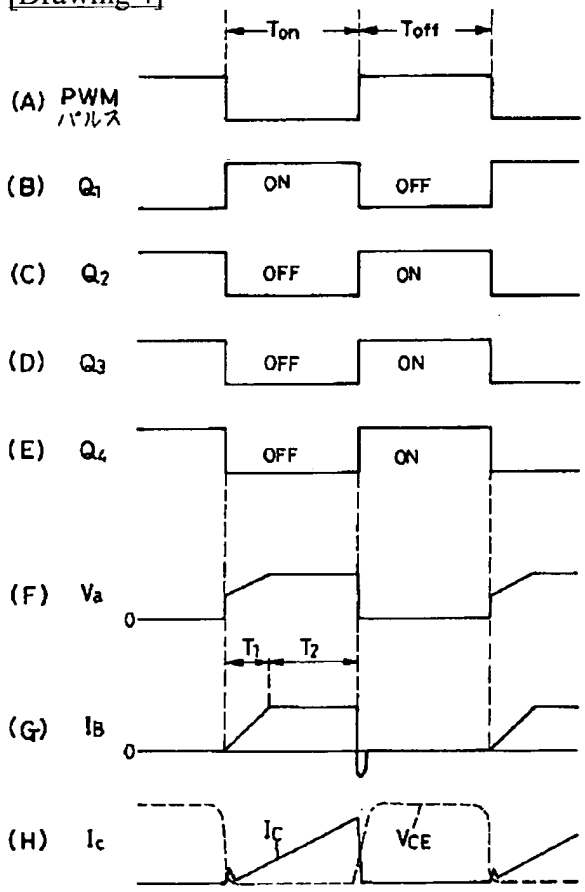
[Drawing 2]



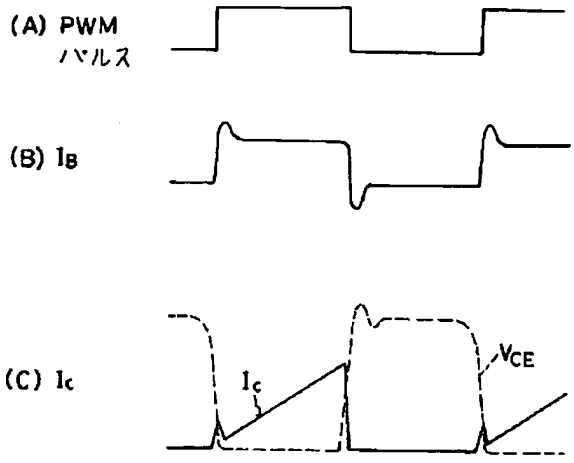
[Drawing 3]



[Drawing 4]



[Drawing 5]



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